

PB-237 607

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE:
PHOSPHATE FERTILIZER INDUSTRY
VOLUME 2. TEST DATA SUMMARY

ENVIRONMENTAL PROTECTION AGENCY

OCTOBER 1974

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16. ABSTRACT This document provides background information on the derivation of the Standards of performance for the phosphate fertilizer industry. Volume 1 provides a general description of the facilities for which standards are proposed and provides the rationale for the proposed standards of performance. Volume 2 presents summaries of the emission testing data cited in Volume 1. The summaries are concerned principally with tests for fluorides and visible emissions, but also describe the facilities, characteristics of the exhaust gas streams, and conditions of operation.		
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FOR STANDARDS OF PERFORMANCE:
PHOSPHATE FERTILIZER INDUSTRY
VOLUME 2: TEST DATA SUMMARY**

Emission Standards and Engineering Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
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October 1974

1-A

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CONTENTS

<u>Section</u>	<u>Page</u>
INTRODUCTION	1
WET-PROCESS PHOSPHORIC ACID PLANTS	2
Fluoride Test Results	2
Facilities	2
References	16
SUPERPHOSPHORIC ACID PLANTS	17
Fluoride Test Results	17
Facilities	17
References	21
DIAMMONIUM PHOSPHATE PLANTS	22
Fluoride Test Results	22
Facilities	22
References	30
RUN-OF-PILE TRIPLE SUPERPHOSPHATE MANUFACTURING PLANTS AND STORAGE PILES	31
Fluoride Test Results	31
Facilities	31
References	40
GRANULAR TRIPLE SUPERPHOSPHATE PRODUCTION PLANTS	41
Fluoride Test Results	41
Facilities	41
References	49
GRANULAR TRIPLE SUPERPHOSPHATE STORAGE FACILITIES	50
Fluoride Test Results	50
Facilities	50
References	58
TECHNICAL REPORT DATA SHEET	59

INTRODUCTION

This document presents summaries of source tests and visible emission measurements cited in Volume 1 of this background information document. It is concerned principally with tests for fluorides, but also describes the facilities tested, their operating conditions, and characteristics of exhaust gas streams.

Facilities are identified by the same coding used in Volume 1. For example, for wet process phosphoric acid plants, Table 1 summarizes the results of EPA tests conducted in December of 1971 at Facility A. These same results are also plotted on Figure 7 of Volume 1 identified as EPA test results at Plant A.

Many of the tests summarized herein were conducted using EPA Method 13 which will be proposed in the Federal Register at or before the time of proposal of standards of performance for five processes in the phosphate fertilizer industry.

The types of facilities covered by the proposed regulation and covered in this document are as follows:

1. Wet-process phosphoric acid plants.
2. Superphosphoric acid plants.
3. Diammonium phosphate plants.
4. Run-of-pile triple superphosphate plants.
5. Granular triple superphosphate plants.
6. Storage of granular triple superphosphate.

WET-PROCESS PHOSPHORIC ACID (WPPA) PLANTS

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified WPPA plants. Three plants, identified as A, B, and C were tested by EPA. Additional data reported include two plants, identified as D and E, tested during a joint study by the Manufacturing Chemists' Association and the U. S. Public Health Service. Data submitted by operators of plants A, B, and C are also included. All of the plants were operating at or near design capacity during the tests. All plants used scrubbers to control fluorides. These scrubbers were operating normally during all EPA tests.

Figure 1 presents emission rates (pounds of fluorides per ton of P_2O_5 input to the process) for the six plants.

The test results of 0.0638 lb F/ton P_2O_5 reported for Run Number 1 at Plant A are not believed to be accurate. Plant A routinely measures emissions from the plant. The highest valid fluoride emissions recorded by this plant in 1972 (78 test runs) was 0.053 lb F/ton P_2O_5 .

Facilities

- A. Conventional multi-compartment tank reactor (Prayon continuous process) designed for a production rate of 660 TPD P_2O_5 . The plant was operating at 25 percent above design capacity during the EPA tests. EPA data are based on samples obtained using EPA Method 13 for fluorides. The operator collected samples using the State of Florida method for fluorides. In this method, sampling is conducted at the point of

average gas velocity. Two Greenberg-Smith impingers containing 20 milliliters of distilled water are used. The probe washing and impinger solutions are included in the analysis. Fluoride emissions from the reactor, the filter, and miscellaneous sources are controlled by a spray-concurrent packed scrubber. Gypsum pond water is used as the scrubbing medium. Opacity of exhaust gases was less than 10 percent during the EPA tests.

- B. Conventional multi-compartment tank reactor (Prayon continuous process) designed for a production rate of 550 TPD P_2O_5 . The plant was operating at 30 percent above design capacity during the EPA tests. EPA data are based on samples obtained using Method 13. The operator collected samples using the State of Florida method. Fluoride emissions from the reactor, filter, and miscellaneous sources are controlled by a spray-crossflow packed scrubber. Gypsum pond water is used as the scrubbing medium. Opacity of exhaust gases was less than 10 percent during the EPA tests. Additional visible emission observations were made by EPA contractor personnel at another time. EPA Method 9 was used for these observations.
- C. Conventional multi-compartment tank reactor (Prayon continuous process) designed for a production rate of 525 TPD P_2O_5 . The plant was operating at 95 percent of design capacity during the first EPA test (designated C_1) and at 27 percent above design capacity during a second EPA test (designated C_2). EPA data are based on samples obtained using Method 13. The operator collected samples using the State of Florida method. Fluoride emissions from the reactor, filter, and

miscellaneous sources are controlled by a spray-crossflow packed scrubber. Gypsum pond water is used as the scrubbing medium. Opacity of exhaust gases was less than 10 percent during EPA tests.

- D. Conventional multi-compartment tank reactor (Prayon continuous process) designed for a production rate of 660 TPD P_2O_5 . The plant was operating at six percent above design capacity during the test and was tested by the U. S. Public Health Service using their test method. The test train is similar to that for EPA Method 5 except there are three wet impingers. Fluoride emissions from the reactor, filter, and miscellaneous sources are controlled by a spray-crossflow packed scrubber. Gypsum pond water is used as the scrubbing medium. Opacity of exhaust gases was not reported.
- E. Two WPPA production lines controlled by a common scrubber. Each line is of the Dorr-Oliver single-tank reactor design and is designed for a production rate of 600 TPD P_2O_5 . The plant was operating at 10 percent below design production rate during the test. The fluoride scrubbing system consists of two impingement scrubbers in series. This scrubbing system also serves part of a nearby triple superphosphate plant. This connection was closed off during sampling. The plant was tested by the U. S. Public Health Service using their test method. Opacity of exhaust gases was not reported.

FIGURE 1.

FLUORIDE EMISSIONS FROM WET-PROCESS PHOSPHORIC ACID PLANTS

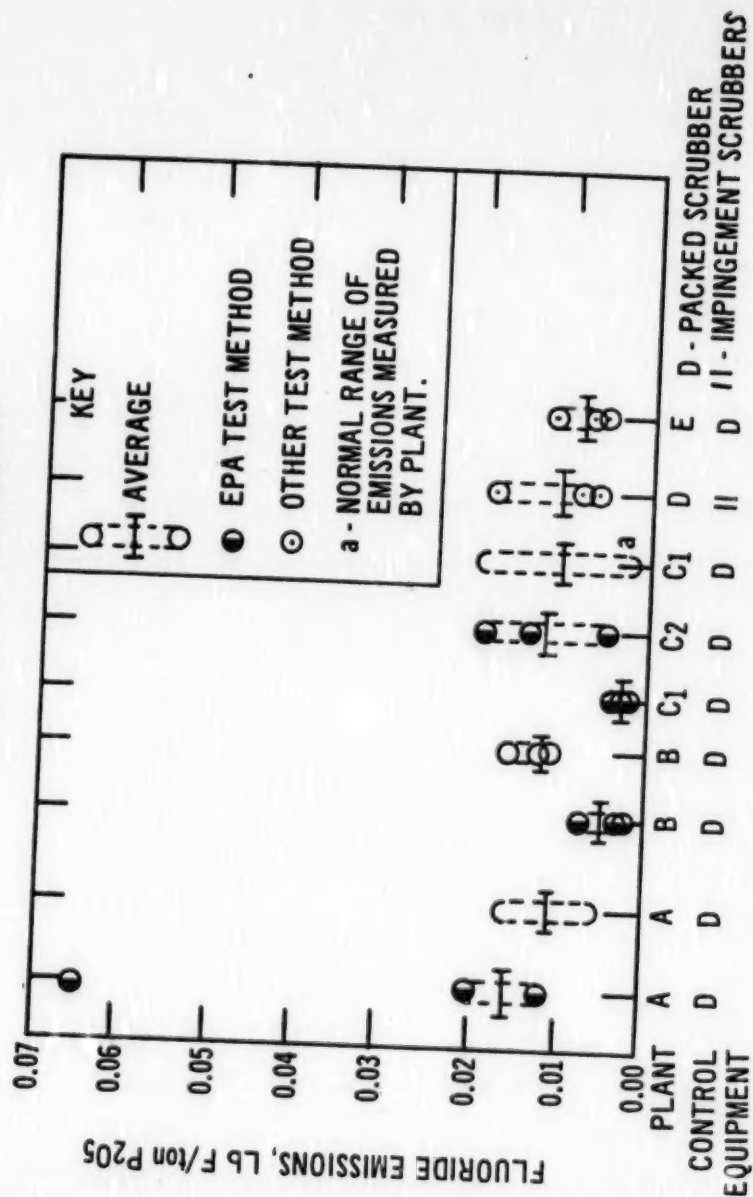


Table 1
FACILITY A
Summary of Results
of Test by EPA

Run Number	1 (a)	2	3	Average (a)
Date	12/14/71	12/15/71	12/15/71	-
Test Time-minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	31.6	31.6	31.6	31.6
Scrubber Operation				
Pressure Drop - In. H ₂ O	6	6	6	6
L/G ratio - gal/SCF	111	111	111	0.043 ^(b)
No. transfer units	2.68	4.44	3.29	3.87
Stack Effluent				
Flow rate - DSCFM	34,327	33,384	34,635	34,010
Flow rate - DSCF/ton P ₂ O ₅	65,212	63,421	65,797	64,609
Temperature - °F	85	85	84	85
Water vapor - Vol. %	3.8	4.1	3.8	3.9
CO ₂ - Vol. % dry	<0.2	<0.2	0.5	<0.3
O ₂ - Vol. % dry	20.0	20.2	20.5	20.3
CO - Vol. % dry	<0.2	<0.2	<0.2	<0.2
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0062	0.0012	0.0020	0.0016
gr/ACF	0.0065	0.0012	0.0019	0.0016
lb/hr	2.02	0.35	0.59	0.47
lb/ton of P ₂ O ₅	0.0638	0.0112	0.0186	0.0149

111 - Not Measured

(a) - Run Number 1 is not an accurate measure of this plant's emissions. The average is computed as the average emissions measured during run numbers 2 and 3.

(b) - Calculated using the design scrubbing liquor flow rate and the average measured stack gas flow rate.

Reference 1.

Table 2
FACILITY A
Summary of Results
of Test by Operator

Run Number	1	2	Average
Date	12/71	12/71	
Test Time-minutes	NR	NR	
Production rate - TPH P_2O_5	NR	NR	
Scrubber Operation			
Pressure Drop - In. H_2O	NR	NR	
L/G ratio - gal/SCF	NR	NR	
No. transfer units	NR	NR	
Stack Effluent			
Flow rate - DSCFM			
Flow rate - DSCF/ton	NR	NR	
Temperature - °F	NR	NR	
Water vapor - Vol. %	NR	NR	
CO_2 - Vol. % dry	NR	NR	
O_2 - Vol. % dry	NR	NR	
CO - Vol. % dry	NR	NR	
Visible Emissions - % opacity	NR	NR	
Fluoride Emissions			
gr/DSCF	NR	NR	
gr/ACF	NR	NR	
lb/hr	0.22	0.55	0.39
lb/ton of P_2O_5	0.007	0.018	0.013

NR - Not Reported

(a) - Calculated from the plants normal production rate and the emission rate (in lb/hr) submitted by the plant operator.

Reference 2.

Table 3
FACILITY B
Summary of Results
of Test by EPA

Run Number	1	2	3	Average
Date	1/4/72	1/5/72	1/5/72	-
Test Time-minutes	120	120	120	120
Production rate - TPH P_2O_5	30.0	30.3	30.5	30.3
Scrubber Operation				
Pressure Drop - In. H_2O	NM	NM	NM	5(a)
L/G ratio - gal/SCF	NM	NM	NM	0.078(b)
No. transfer units	2.82	3.28	3.96	3.69
Stack Effluent				
Flow rate - DSCFM	15,981	16,832	16,825	16,546
Flow rate - DSCF/ton	31,962	33,331	33,098	32,797
Temperature - °F	93.8	94.2	96.4	94.8
Water vapor - Vol.%	4.9	5.2	5.2	5.1
CO ₂ - Vol.% dry	NM	NM	NM	-
O ₂ - Vol.% dry	NM	NM	NM	-
CO - Vol.% dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0010	0.0018	0.0009	0.0012
gr/ACF	0.0009	0.0016	0.0008	0.0011
lb/hr	0.135	0.252	0.125	0.171
lb/ton of P_2O_5	0.0045	0.0083	0.0041	0.0056

(a) - Design

(b) - Calculated using the design scrubbing liquor flow rate and the average measured stack gas flow rate.

NM - Not Measured.

Reference 3.

Table 4
FACILITY B
Summary of Results
of Test by Operator

Run Number	1	2	3	Average
Date	1/72	1/72	1/72	-
Test Time-minutes	NR	NR	NR	NR
Production rate - TPH P_2O_5	NR	NR	NR	NR
Scrubber Operation				
Pressure Drop - In. H_2O	NR	NR	NR	NR
L/G ratio - gal/SCF	NR	NR	NR	NR
No. transfer units	NR	NR	NR	NR
Stack Effluent				
Flow rate - DSCFM	NR	NR	NR	NR
Flow rate - DSCF/ton	NR	NR	NR	NR
Temperature - $^{\circ}F$	NR	NR	NR	NR
Water vapor - Vol. %	NR	NR	NR	NR
CO_2 - Vol. % dry	NR	NR	NR	NR
O_2 - Vol. % dry	NR	NR	NR	NR
CO - Vol. % dry	NR	NR	NR	NR
Visible Emissions - % opacity				
Fluoride Emissions				
gr/DSCF	NR	NR	NR	NR
gr/ACF	NR	NR	NR	NR
lb/hr	NR	NR	NR	NR
lb/ton of $P_2O_5^{(a)}$	0.013	0.012	0.015	0.013

NR - Not Reported

(a) - Calculated using the emission rate (in lb/ton) submitted by operator and the plant's normal production rate.

Reference 4.

Table 5
FACILITY B
SUMMARY OF VISIBLE EMISSIONS⁽¹⁾

Date: 2/26/74

Type of Plant: Wet-Process Phosphoric Acid

Type of Discharge: Stack from scrubber

Location of Discharge: Top of stack

Height of Point of Discharge: 100 ft

Description of Background: Sky

Distance from Observer to Discharge Point: ~ 400 ft

Height of Observation Point: ~ 5 ft

Direction of Observer from Discharge Point: East

Description of Sky: Clear

Wind Direction: From south

Color of Plume: White

Interference of Steam Plume: Yes

Duration of Observation: 4 hrs.

Wind Velocity: ~ 15 - 20

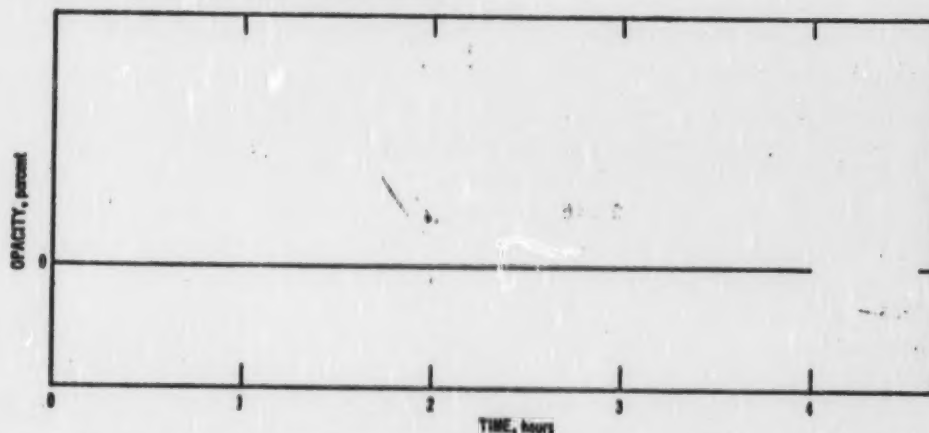
mi/hr

Detached Plume: No

Summary of Data:

Opacity, Percent	Total Time Equal to or Greater Than Given Opacity		Opacity, Percent	Total Time Equal to or Greater Than Given Opacity	
	Min.	Sec.		Min.	Sec.
5	0	0	55	-	-
10	-	-	60	-	-
15	-	-	65	-	-
20	-	-	70	-	-
25	-	-	75	-	-
30	-	-	80	-	-
35	-	-	85	-	-
40	-	-	90	-	-
45	-	-	95	-	-
50	-	-	100	-	-

Sketch Showing How Opacity Varied With Time:



(1) Two observers made simultaneous readings. The greater of their readings is reported.

Reference 5.

Table 6
FACILITY C₁
Summary of Results
of Test by EPA

Run Number	1	2	3	Average
Date	11/17/71	11/17/71	11/18/71	-
Test Time-minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	20.8	20.8	20.8	20.8
Scrubber Operation				
Pressure Drop - In. H ₂ O	121	121	121	6 ^(a)
L/G ratio - gal/SCF	121	121	121	0.06 ^(b)
No. transfer units	121	121	121	-
Stack Effluent				
Flow rate - DSCFM	17,855	19,232	16,746	17,944
Flow rate - DSCF/ton P ₂ O ₅	50,904	56,118	47,697	51,573
Temperature - °F	75	73	72	73
Water vapor - Vol.%	1.1	1.0	1.9	1.3
CO ₂ - Vol.% dry	121	121	121	-
O ₂ - Vol.% dry	121	121	121	-
CO - Vol.% dry	121	121	121	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0003	0.0002	0.0005	0.0003
gr/ACF	0.0003	0.0002	0.0005	0.0003
lb/hr	0.046	0.033	0.072	0.050
lb/ton of P ₂ O ₅	0.0022	0.0016	0.0034	0.0024

121 - Not Measured

(a) - Design

(b) - Calculated from design scrubbing liquor flow rate and average measured stack gas flow rate.
Reference 6.

Table 7
FACILITY C2
Summary of Results
of Test by EPA

Run Number	1	2	3	Average
Date	8/31/72	8/31/72	9/1/72	-
Test Time-minutes	120	120	80.5	107
Production rate - TPH P_2O_5	26.9	27.1	29.1	27.7
Scrubber Operation				
Pressure Drop - In. H_2O	NM	NM	NM	6(a)
L/G ratio - gal/SCF	0.07	0.08	0.05	0.07
NO. transfer units	111	111	111	111
Stack Effluent				
Flow rate - DSCFM	14,363	12,462	19,149	15,325
Flow rate - DSCF/ton P_2O_5	32,036	27,591	39,482	33,036
Temperature - $^{\circ}F$	93	92	79	88
Water vapor - Vol. %	4.7	4.4	4.4	4.5
CO_2 - Vol. % dry	111	111	111	111
O_2 - Vol. % dry	111	111	111	111
CO - Vol. % dry	111	111	111	111
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.004	0.004	0.001	0.003
gr/ACF	0.004	0.003	0.001	0.003
lb/hr	0.5	0.4	0.1	0.3
lb/ton of P_2O_5	0.0184	0.0143	0.0031	0.0119
111 - Not Measured				

(a) - Design

Reference 7.

Table 8
FACILITY C₁
Summary of Results
of Tests by Operator

Run Number	RAIGE
Date	1971
Test Time-minutes	NR
Production rate - TPH P ₂ O ₅	25 ^(a)
Scrubber Operation	
Pressure Drop - In. H ₂ O	NR
L/G ratio - gal/SCF	NR
No. transfer units	NR
Stack Effluent	
Flow rate - DSCFM	NR
Flow rate - DSCF/ton	NR
Temperature - °F	NR
Water vapor - Vol.%	NR
CO ₂ - Vol.% dry	NR
O ₂ - Vol.% dry	NR
CO - Vol.% dry	NR
Visible Emissions - % opacity	NR
Fluoride Emissions	
gr/DSCF	NR
gr/ACF	NR
lb/hr	0.05-0.5
lb/ton of P ₂ O ₅	0.002-0.02
NR - Not Reported	

(a) - Normal production rate (not recorded during test).

(b) - Calculated from assumed production rate and emission rates (in lb/ton) submitted by operator.

Reference 8.

Table 9
FACILITY D
Summary of Results of
Test by U. S. Public Health Service

Run Number	1	2	3	Average
Date	NR	NR	NR	-
Test Time-minutes (a)	NR	NR	NR	-
Production rate - TPH P ₂ O ₅	28.5	28.9	28.8	28.7
Scrubber Operation				
Pressure Drop - In. H ₂ O	NR	NR	NR	-
L/G ratio - gal/SCF	0.043	0.042	0.044	0.043
No. transfer units	NR	NR	NR	
Stack Effluent				
Flow rate - DSCFM (b)	18,685	19,118	18,338	18,714
Flow rate - DSCF/ton P ₂ O ₅ (b)	39,189	39,691	38,204	39,028
Temperature - °F	90	90	90	90
Water vapor - Vol. %	NR	NR	NR	NR
CO ₂ - Vol. % dry	NR	NR	NR	NR
O ₂ - Vol. % dry	NR	NR	NR	NR
CO - Vol. % dry	NR	NR	NR	NR
Visible Emissions - % opacity	NR	NR	NR	NR
Fluoride Emissions				
gr/DSCF	0.0032	0.0015	0.0011	0.0019
gr/ACF	NR	NR	NR	NR
lb/hr	0.513	0.246	0.173	0.311
lb/ton of P ₂ O ₅	0.0180	0.0085	0.0060	0.0108

NR - Not Reported

(a) - Probably 15 minutes per sample

(b) - Calculated, not reported

Reference 9.

Table 10
FACILITY E
Summary of Results of
Test by U. S. Public Health Service

Run Number	1	2	3	Average
Date	NR	NR	NR	NR
Test Time-minutes (a)	NR	NR	NR	NR
Production rate - TPH P_2O_5 (b)	45.4	45.2	45.1	45.3
Scrubber Operation				
Pressure Drop - In. H_2O	NR	NR	NR	NR
L/G ratio - gal/SCF	NR	NR	NR	NR
No. transfer units	NR	NR	NR	NR
Stack Effluent				
Flow rate - DSCFM	16,670	16,670	16,670	16,670
Flow rate - DSCF/ton P_2O_5	22,031	22,128	22,177	22,112
Temperature - $^{\circ}F$	NR	NR	NR	NR
Water vapor - Vol. %	NR	NR	NR	NR
CO_2 - Vol. % dry	NR	NR	NR	NR
O_2 - Vol. % dry	NR	NR	NR	NR
CO - Vol. % dry	NR	NR	NR	NR
Visible Emissions - % opacity	NR	NR	NR	NR
Fluoride Emissions				
gr/DSCF	0.0037	0.0020	0.0024	0.0027
gr/ACF	NR	NR	NR	NR
lb/hr	0.508	0.271	0.325	0.368
lb/ton of P_2O_5	0.0112	0.0060	0.0072	0.0081

NR - Not Reported

(a) - Probably 15 minutes per sample.

(b) - Calculated, not measured.

Reference 9.

REFERENCES

Wet Process Phosphoric Acid Plant Data

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SUPERPHOSPHORIC ACID (SPA) PLANTS

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified superphosphoric acid fertilizer plants. Only one plant, identified as A, was tested since this plant has demonstrated far better fluoride control than any other SPA fertilizer plant. The plant uses a scrubber to control fluorides. The scrubber was operating normally during the EPA tests.

Figure 2 presents the emission rate (pounds of fluoride per ton of P_2O_5 input to the process) for the plant.

Facilities

A. This facility uses a vacuum evaporator to produce 70-72 percent P_2O_5 phosphoric acid (SPA) from 54 percent P_2O_5 phosphoric acid. The design production rate is 280 TPD P_2O_5 . The plant was operating at 25 percent above design capacity during the EPA tests. Data are based on samples obtained using EPA Method 13. This facility was tested twice, and the two tests are designated A_1 and A_2 , respectively. Fluoride emissions from the barometric condenser hotwell and the product acid cooling tank are controlled by a water-induced venturi scrubber. Gypsum pond water is used as the scrubbing medium. Opacity of stack gases was less than 10 percent.

FIGURE 2
FLUORIDE EMISSIONS FROM SUPERPHOSPHORIC ACID PLANTS

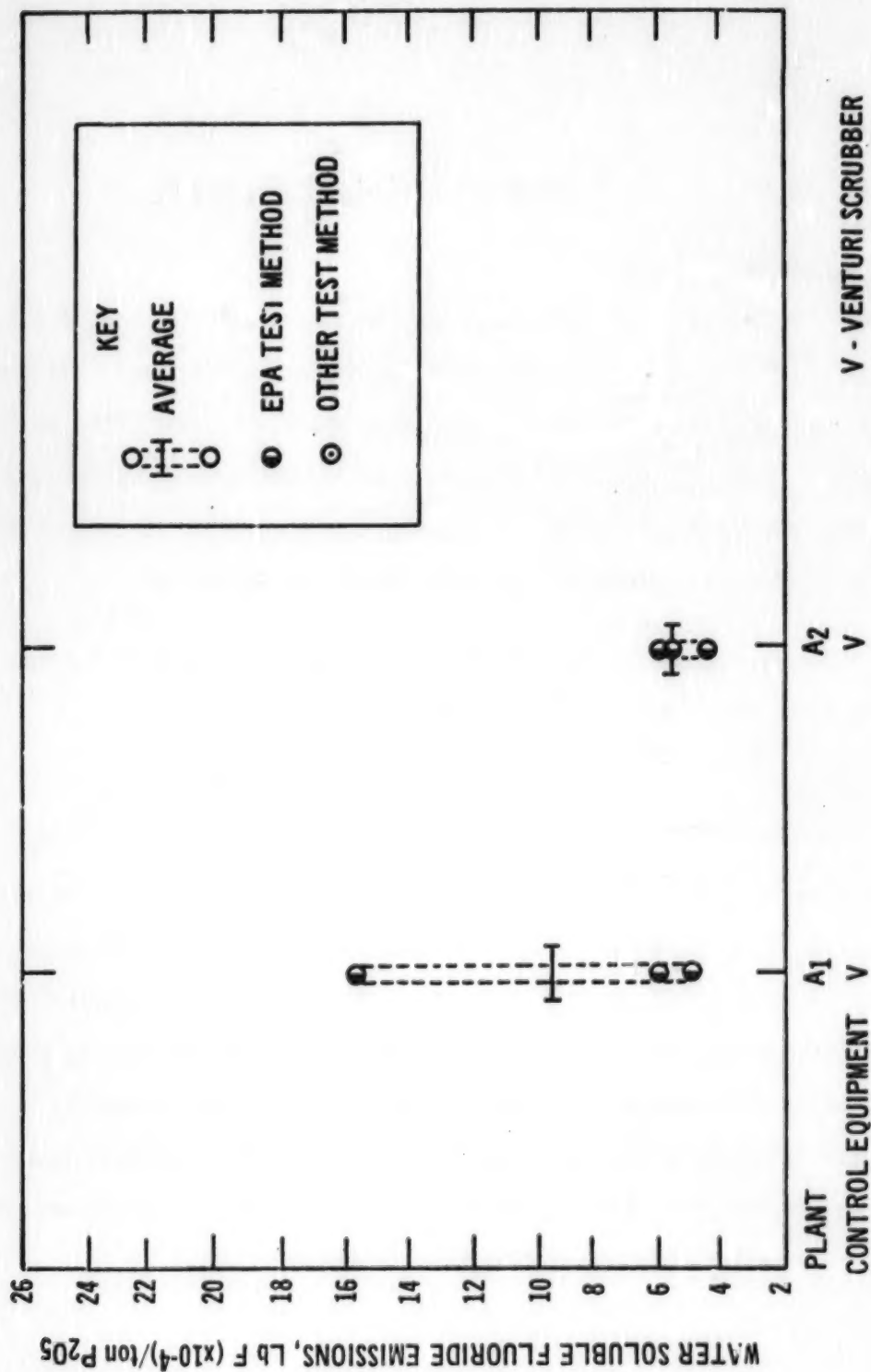


Table 11
FACILITY A₁
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	11/19/71	11/19/71	11/19/71	
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	14.6	14.6	14.6	14.6
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	0.1(a)
L/G ratio - gal/SCF	NM	NM	NM	0.2(a)
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - D.	420	420	420	420
Flow rate - USCF/ton P ₂ O ₅	1726	1726	1726	1726
Temperature - °F	72	72	71	72
Water vapor - Vol. %	1.9	1.9	1.8	1.9
CO ₂ - Vol. % dry	<0.2	NM	NM	-
O ₂ - Vol. % dry	19.2	NM	NM	-
CO - Vol. % dry	<0.2	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0022	0.0062	0.0020	0.0035
gr/ACF	0.0022	0.0061	0.0020	0.0035
lb/hr	0.008	0.022	0.007	0.012
lb/ton of P ₂ O ₅	0.0006	0.0015	0.0005	0.0009

NM - Not Measured
(a) - Typical value

Reference 1.

Table 12
FACILITY A₂
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	8/29/72	8/29/72	8/30/72	
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	11.86	11.73	13.19	12.26
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	0.1 ^(a)
L/G ratio - gal/SCF	NM	NM	NM	0.2 ^(a)
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	305	302	308	305
Flow rate - DSCF/ton P ₂ O ₅	1538	1549	1400	1496
Temperature - °F	77.5	82	82	80.5
Water vapor - Vol. %	2.8	3.6	1.5	2.6
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0021	0.0019	0.0026	0.0022
gr/ACF	0.0020	0.0018	0.0025	0.0021
lb/hr	0.0054	0.0048	0.0069	0.0057
lb/ton of P ₂ O ₅	0.00046	0.00041	0.00052	0.00046

NM - Not Measured
(a) - Typical value

Reference 2.

REFERENCES

Superphosphoric Acid Plant Data

1. Emission Test Report for SPA Facility A, prepared for EPA by Environmental Engineering, Inc., Contract No. CPA 70-82, EPA Test No. 71-CI-32.
2. Emission Test Report for SPA Facility A (Second Test), prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 73-PSA-1.

DIAMMONIUM PHOSPHATE (DAP) PLANTS

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified DAP plants. Two plants, identified as A and B were tested by EPA.

Emission data submitted by operators of Plants A and B are also reported. Both plants use scrubbers to control fluorides. The scrubbers were operating normally during all EPA tests.

Figure 3 presents the emission rates (pounds of fluorides per ton of P₂O₅ input to the process) for the two plants.

Facilities

- A. Conventional continuous DAP manufacturing train consisting of a reactor, a granulator, a dryer, and a cooler. Reactor-granulator emissions, dryer emissions, and cooler emissions are vented to individual venturi scrubbers followed by spray-crossflow packed scrubbers. EPA data are based on samples collected using Method 13. Operator data are based on samples collected using the state of Florida method for fluorides. The design production rate is 331 TPD P₂O₅. The plant was operating at 53 percent above the design production rate during the EPA test. Production rate during the operator's test is unknown. Opacity of exhaust gases was less than 10 percent.
- B. Conventional DAP manufacturing train consisting of a reactor, a granulator, a dryer, and a cooler. The design production rate is 345 TPD P₂O₅. Reactor-granulator emissions, dryer emissions, and

cooler emissions are vented to individual venturi scrubbers followed by spray-crossflow packed scrubbers. The scrubbing medium used in the venturi scrubbers is 25 percent P_2O_5 phosphoric acid. Gypsum pond water is used in the packed scrubbers. The plant operator collected data while fluoride free water was being used in the packed scrubbers controlling the reactor-granulator and dryer emissions. The plant tests were performed using the company's own test method. This method is similar to EPA Method 13 except that sampling is conducted non-isokinetically, a particulate and condensate collector is used before the impingers, and the first impinger contains 100 milliliters of weak sodium hydroxide solution. EPA samples were collected using EPA Method 13. Opacity of exhaust gases and production rate during operator conducted tests are unknown.

FIGURE 3

FLUORIDE EMISSIONS FROM DIAMMONIUM PHOSPHATE PLANTS

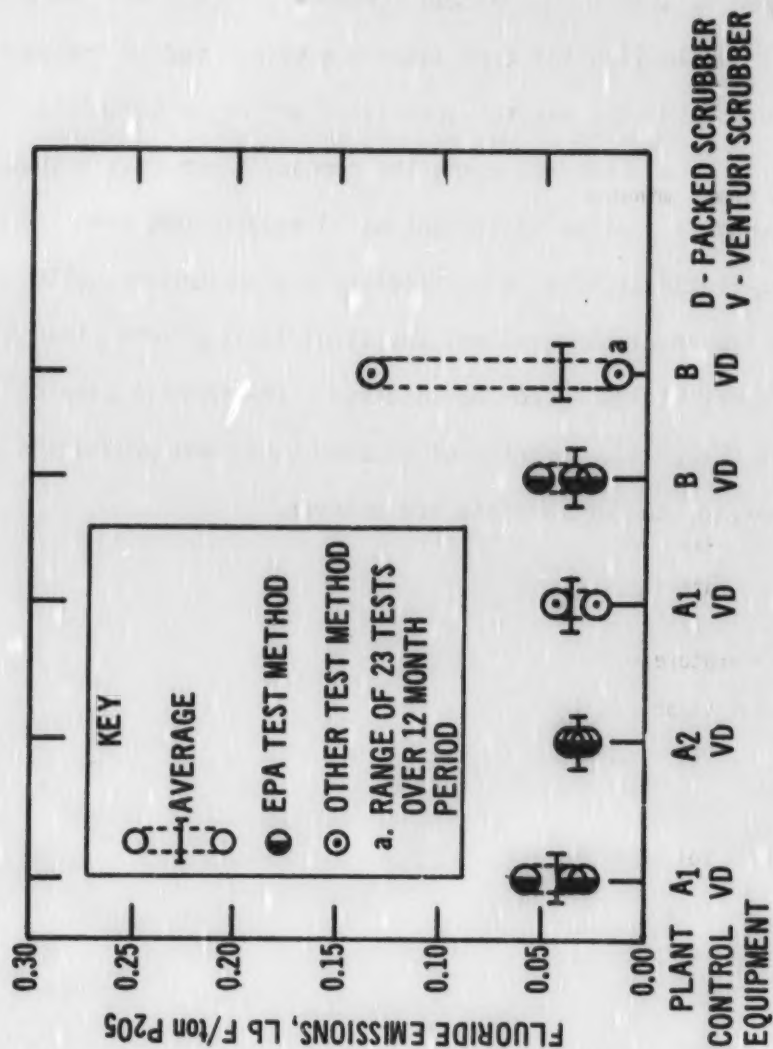


Table 13
FACILITY A₁
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	1/19/72	1/20/72	1/20/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	21	22	21	21
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	1-5 ^(a)
L/G ratio - gal/SCF	NM	NM	NM	0.012 ^(b)
No. transfer units	1.7	2.0	1.6	1.8
Stack Effluent				
Flow rate - DSCFM	106,917	99,051	98,964	101,644
Flow rate - DSCF/ton P ₂ O ₅	305,477	270,139	282,754	286,123
Temperature - °F	94.6	100.0	99.7	98.1
Water vapor - Vol. %	4.6	5.4	5.6	5.2
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0012	0.0007	0.0006	0.0008
gr/ACF	0.0011	0.0007	0.0006	0.0008
lb/hr	1.10	0.59	0.51	0.73
lb/ton of P ₂ O ₅	0.0523	0.0270	0.0243	0.0345

NM - Not Measured
(a) - Normal range
(b) - Estimate
Reference 1.

Table 1A
FACILITY A₂
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	9/26/72	9/27/72	9/27/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	20.7	20.7	20.7	20.7
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	NM
L/G ratio - gal/SCF	NM	NM	NM	NM
No. transfer units	NM	NM	NM	NM
Stack Effluent				
Flow rate - DSCFM	94,225	85,586	80,346	86,719
Flow rate - DSCF/ton P ₂ O ₅	273,114	248,075	232,887	251,359
Temperature - °F	109	109	111	109.7
Water vapor - Vol. %	6.1	6.3	6.6	6.3
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0008	0.0008	0.0008	0.0008
gr/ACF	0.0007	0.0007	0.0007	0.0007
lb/hr	0.67	0.56	0.53	0.59
lb/ton of P ₂ O ₅	0.0324	0.0272	0.0261	0.0286

NM - Not Measured

Reference 2.

Table 15
FACILITY A,
Summary of Results of Test by Operator

Run Number	1	2	3	Average
Date	1/19/72	1/19/72	1/19/72	-
Test time - minutes	NR	NR	NR	NR
Production rate - TPH P_2O_5	NR	NR	NR	NR
Scrubber Operation				
Pressure drop - In. H_2O	NR	NR	NR	NR
L/G ratio - gal/SCF	NR	NR	NR	NR
No. transfer units	NR	NR	NR	NR
Stack Effluent				
Flow rate - DSCFM	NR	NR	NR	NR
Flow rate - DSCF/ton P_2O_5	NR	NR	NR	324,427 ^(a)
Temperature - °F				
Water vapor - Vol. %	NR	NR	NR	NR
CO ₂ - Vol. % dry	NR	NR	NR	NR
O ₂ - Vol. % dry	NR	NR	NR	NR
CO - Vol. % dry	NR	NR	NR	NR
Visible Emissions - % opacity	NR	NR	NR	NR
Fluoride Emissions				
gr/DSCF ^(b)	0.0006	0.0007	0.0009	0.0007
gr/ACF	NR	NR	NR	NR
lb/hr	0.55	0.73	0.87	0.72
lb/ton of P_2O_5 ^(c)	0.026	0.035	0.041	0.034

(a) - Calculated using an assumed stack gas flow rate.

(b) - Calculated by using emission data submitted by plant officials and an assumed stack gas flow rate.

(c) - Calculated by using emission data submitted by plant officials and normal production rate of plant.

NR - Not reported

Reference 3

Table 16
FACILITY B
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	3/21/73	3/21/73	3/22/73	-
Test time - minutes	120	120	120	120
Production rate - TPH P_2O_5	14.0	15.3	18.2	15.8
Scrubber Operation				
Pressure drop - In. H_2O	NM	NM	NM	2-4 ^(a)
L/G ratio - gal/SCF	NM	NM	NM	0.013 ^(b)
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	135,060	142,550	129,498	135,703
Flow rate - DSCF/ton P_2O_5	578,829	559,020	426,916	521,588
Temperature - °F	112	112	114	113
Water vapor - Vol. %	6.5	6.6	6.5	6.5
CO_2 - Vol. % dry	0.3	0.6	0.2	0.4
O_2 - Vol. % dry	20.5	21.0	20.2	
CO - Vol. % dry	<0.6	<0.6	<0.6	<0.6
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0004	0.0007	0.0004	0.0005
gr/ACF	0.0003	0.0006	0.0003	0.0004
lb/hr	0.485	0.849	0.465	0.600
lb/ton of P_2O_5	0.035	0.055	0.026	0.039

NM - Not Measured

(a) - Normal range per scrubber (reported by plant operator).

(b) - Calculated by using design scrubbing water flow rates and the measured average gas flow rate.
Reference 4.

Table 17
FACILITY B
Summary of Results of Test by Operator

Run Number	Average ^(a)
Date	6/31/71 to 5/31/72
Test time - minutes	NR
Production rate - TPH P ₂ O ₅	14.37
Scrubber Operation	
Pressure drop - In. H ₂ O	NR
L/G ratio - gal/SCF	0.009
No. transfer units	NR
Stack Effluent	
Flow rate - DSCFM ^(b)	130,000 - 150,000
Flow rate - USCF/ton	542,608 - 626,047
Temperature - °F	100 - 150
Water vapor - Vol. %	NR
CO ₂ - Vol. % dry	NR
O ₂ - Vol. % dry	NR
CO - Vol. % dry	NR
Visible Emissions - % opacity	NR
Fluoride Emissions	
gr/DSCF ^(c)	0.0005
gr/ACF	NR
lb/hr ^(a)	0.592
lb/ton of P ₂ O ₅ ^(d)	0.041

References 5 and 6.

- NR - Not Reported
 (a) - Data expressed as an average of 23 emission tests taken during the period shown by the above dates.
 (b) - Approximate range.
 (c) - Calculated using 0.592 lb/hr and 140,000 USCFM.
 (d) - Calculated using production rate of 345 tons P₂O₅ per day (production rate given by plant officials).

REFERENCES

Diammonium Phosphate Plant Data

1. Emission Test Report for DAP Facility A, prepared for EPA by Environmental Engineering, Inc., Contract No. CPA-70-82, EPA Test No. 72-CI-3.
2. Emission Test Report for DAP Facility A (Retest), prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 73-FRT-13.
3. Data supplied to EPA by the owner of DAP Facility A.
4. "Source Testing Report," for DAP Facility B, prepared by Midwest Research Institute, Contract No. 68-02-0228, Task 22, EMB Project No. 73-FRT-1.
5. Letter and attachment from the plant manager of Plant B to Lee Beck, EPA, October 18, 1972.
6. Letter and attachments from the plant manager of Plant B to Andrew R. Trenholm, EPA, October 4, 1972.

RUN-OF-PILE TRIPLE SUPERPHOSPHATE (ROP-TSP)
MANUFACTURING PLANTS AND STORAGE PILES

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified ROP-TSP manufacturing plants and storage facilities. Two plants, identified as A and B, were tested by EPA. Emission data submitted by operators of Plants A and B are also reported. Both plants were operating at or near design capacity during the tests and scrubbers were operating normally during all EPA tests.

Figure 4 presents the emission rate (pounds of fluorides per ton of P_2O_5 input to the process) for the two plants.

Facilities

A. Conventional continuous den ROP-TSP manufacturing train consisting of a mixing cone, a continuous den (setting belt), and a cutter. The design production rate is 372 TPD P_2O_5 . The plant was tested twice (designated as tests A₁ and A₂) by EPA. The design production rate was maintained during all EPA tests. EPA data are based on samples obtained using Method 13. The operator collected samples using the State of Florida method. Emissions from the cone, the continuous den, the transfer conveyors, and the storage pile are controlled by a venturi scrubber followed by a cyclonic scrubber with a packed section. Gypsum pond water is the scrubbing medium used in each of the scrubbers. Opacity of exhaust gases was less than 10 percent during the EPA tests. Additional visible emission data were obtained using EPA Method 9 by EPA and contractor personnel at another time.

B. Conventional continuous den ROP-TSP manufacturing train consisting of a mixing cone, a continuous den (setting belt), and a cutter. The design production rate is 773 TPD P_2O_5 . The plant was operating at about 19 percent above the design rate during both EPA and operator performed tests. EPA data are based on samples obtained using Method 13. The operator collected samples using the State of Florida method. Emissions from the mixer cone and the continuous den are controlled by two cyclonic scrubbers in series with pressure drops of 4.4 and 2.6 in. H_2O , respectively. Emissions from the storage pile are controlled by two different cyclonic scrubbers in series with pressure drops of 3.5 and 4.5 in. H_2O , respectively. Both sets of scrubbers are ducted to a common stack. Gypsum pond water is used as the scrubbing medium in each of the scrubbers. Opacity of the exhaust gases was less than 10 percent.

FIGURE 4

FLUORIDE EMISSIONS FROM RUN-OF-PILE TRIPLE SUPERPHOSPHATE PLANTS

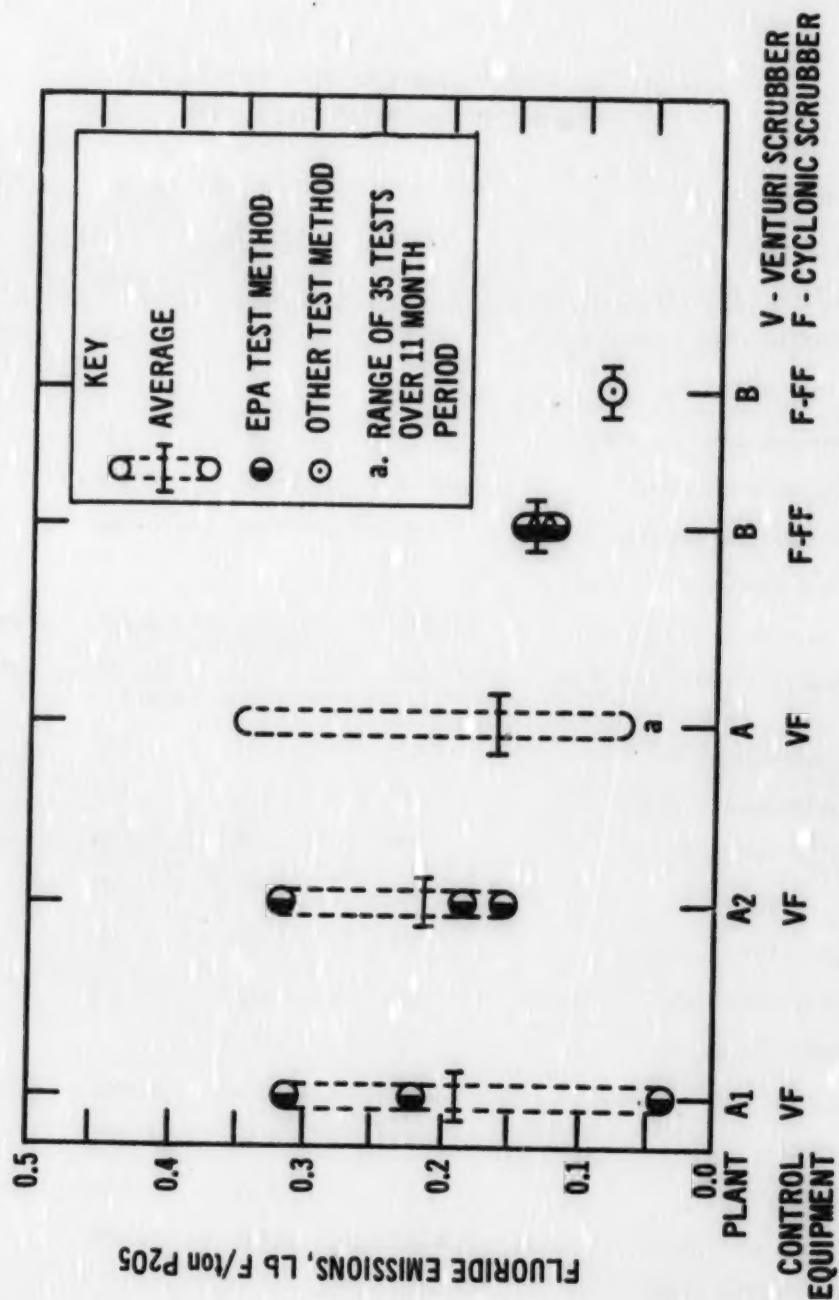


Table 18
FACILITY A₁
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	2/29/72	2/29/72	3/1/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	15.6	16.0	16.6	16.1
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	12-14 ^(a)
L/G ratio - gal/SCF	0.019	0.019	0.019	0.019
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	107,058	106,012	106,681	106,584
Flow rate - DSCF/ton P ₂ O ₅	411,762	397,545	385,593	398,300
Temperature - °F	91.5	90	80.6	87.4
Water vapor - Vol. %	3.0	3.0	0.3	2.1
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0053	0.0040	0.0006	0.0033
gr/ACF	0.0051	0.0038	0.0005	0.0031
lb/hr	5.01	3.65	0.58	3.08
lb/ton of P ₂ O ₅	0.321	0.228	0.035	0.194

NM - Not Measured
(a) - Normal Range

Reference 1.

Table 19
FACILITY A₂
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	9/19/72	9/19/72	9/20/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	17.8	17.7	18.0	17.8
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	12-14 ^(a)
L/G ratio - gal/SCF	0.020	0.020	0.020	0.020
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	97,835	99,215	98,079	98,376
Flow rate - DSCF/ton P ₂ O ₅	329,781	336,322	326,930	331,011
Temperature - °F	101.2	102.4	101.0	101.5
Water vapor - Vol. %	3.2	3.5	3.9	3.5
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0038	0.0063	0.0032	0.0044
gr/ACF	0.0035	0.0057	0.0029	0.0040
lb/hr	3.22	5.37	2.64	3.75
lb/ton of P ₂ O ₅	0.181	0.304	0.147	0.211

NM - Not Measured
(a) - Normal Range
Reference 2.

Table 20
FACILITY A
Summary of Results of Test by Operator

Run Number	Range of 35 Stack Tests	Average
Date	1/12/72 - 12/7/72	
Test time - minutes	NR	
Production rate - TPH P_2O_5	NR	
Scrubber Operation		
Pressure drop - In. H_2O	NR	
L/G ratio - gal/SCF	NR	
No. transfer units	NR	
Stack Effluent		
Flow rate - DSCFM	NR	
Flow rate - DSCF/ton P_2O_5	NR	
Temperature - °F	NR	
Water vapor - Vol. %	NR	
CO_2 - Vol. % dry	NR	
O_2 - Vol. % dry	NR	
CO - Vol. % dry	NR	
Visible Emissions - % opacity	NR	
Fluoride Emissions		
gr/DSCF	NR	
gr/ACF	NR	
lb/hr	1.15 - 5.34	2.34
lb/ton of P_2O_5 ^(a)	0.074 - 0.345	0.151

NR - Not Reported

(a) - Calculated by using the plant's normal production rate (15.5 TPH P_2O_5) and the plant's hourly fluoride emissions.

Reference 3.

SUMMARY OF VISIBLE EMISSIONS ⁽¹⁾

Type of Plant: Run-of-pile triple superphosphate

Distance from Observer to Discharge Point: ~ 400 ft

Height of Observation Point: Ground level

Direction of Observer from Discharge Point: East

Description of Sky: Hazy during the first 2 hours of observation and clear thereafter

Wind Velocity: 0-5 mi/hr

Detached Plume: No

Duration of Observation: 4 hrs.

Opacity, Percent	Total Time Equal to or Greater Than Given Opacity		Opacity, Percent	Total Time Equal to or Greater Than Given Opacity	
	Min.	Sec.		Min.	Sec.
5	237	30	55	-	-
10	56	0	60	-	-
15	12	30	65	-	-
20	3	15	70	-	-
25	0	15	75	-	-
30	0	0	80	-	-
35	-	-	85	-	-
40	-	-	90	-	-
45	-	-	95	-	-
50	-	-	100	-	-

Reference 4.

Table 22
FACILITY B
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	9/14/72	9/15/72	9/15/72	-
Test time - minutes	120	120	120	120
Production rate @ TPH P_2O_5	37.0	38.4	39.5	38.3
Scrubber Operation				
Pressure drop - In. H_2O	NM	NM	NM	(a)
L/G ratio - gal/SCF	0.019	0.019	0.020	0.019
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	60,485	59,578	58,156	59,406
Flow rate - DSCF/ton P_2O_5	98,083	93,091	88,338	93,171
Temperature - °F	100.8	100.5	103.3	101.5
Water vapor - Vol. %	4.8	5.1	5.2	5.0
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0089	0.0094	0.0098	0.0094
gr/ACF	0.0080	0.0085	0.0088	0.0084
lb/hr	4.62	4.82	4.94	4.79
lb/ton of P_2O_5	0.125	0.126	0.125	0.125

NM - Not Measured
(a) - See facility description
Reference 5.

Table 23
FACILITY B
Summary of Results of Test by Operator

Run Number	Range of 51 Tests	Average
Date	1/18/72 - 1/24/73	
Test time - minutes	NR	
Production rate - TPH P_2O_5	NR	
Scrubber Operation		
Pressure drop - In. H_2O	NR	
L/G ratio - gal/SCF	NR	
No. transfer units	NR	
Stack Effluent		
Flow rate - DSCFM	NR	
Flow rate - USCF/ton P_2O_5	NR	
Temperature - °F	NR	
Water vapor - Vol. %	NR	
CO_2 - Vol. % dry	NR	
O_2 - Vol. % dry	NR	
CO - Vol. % dry	NR	
Visible Emissions - % opacity	NR	
Fluoride Emissions		
gr/DSCF	NR	
gr/ACF	NR	
lb/hr	0.704 - 7.40	3.23
lb/ton of P_2O_5 ^(a)	0.022 - 0.230	0.10

NR - Not Reported

(a) - Calculated from the plant's normal production rate (32.2 TPH P_2O_5) and the plant's hourly fluoride emissions.

Reference 6.

REFERENCES

Run-of-Pile Triple Superphosphate Manufacturing Plant and Storage Pile Data

1. Emission Test Report for ROP-TSP Facility A, prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 72-CZ-18.
2. Emission Test Report for ROP-TSP Facility A (Retest), prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 73-FRT-11.
3. Letter from plant manager of Facility A to Lee Beck, EPA, December 12, 1972.
4. "A Review of Field Conditions and Observational Variables Encountered During the Determination of Visible Emissions in the Phosphate Industry for the Environmental Protection Agency," March, 1974, prepared for EPA by Environmental Science and Engineering, Inc.
5. Emission Test Report for ROP-TSP Facility B, prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 73-FRT-10.
6. Letter and attachment from the general manager of Facility B to Don R. Goodwin, EPA, February 16, 1973.

GRANULAR TRIPLE SUPERPHOSPHATE (GTSP) PRODUCTION PLANTS

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified GTSP production plants. Two plants, identified as A and B, were tested by EPA. Both plants were operating at or near design capacity during the EPA tests. Results of a test performed by the operator of Plant A are also included. All of the plants tested use scrubbers to control fluorides. The scrubbers were operating normally during all EPA tests.

Figure 5 presents the emission rate (pounds of fluoride per ton of P_2O_5 input to the process) for the two plants.

Facilities

- A. Conventional production train for continuous GTSP manufacture consisting of a reactor-granulator, dryer, and cooler. Design production rate is 221 TPD P_2O_5 . The plant was tested by EPA twice (tests designated A_1 and A_2). The plant operated at 20 percent above design capacity during the first EPA test (A_1) and at 30 percent above design capacity during the second EPA test (A_2). The production rate during the plant's test is unknown. EPA tests were by Method 13. The operator collected samples using the State of Florida method. Reactor-granulator emissions, dryer emissions, and cooler emissions are vented to individual venturi scrubbers followed by spray-crossflow packed scrubbers. Gypsum pond water is used as the scrubbing medium. Opacity of exhaust gases was less than 10 percent during all EPA tests. Additional visible emission data were obtained using EPA Method 9 by EPA and contractor personnel at another time.

B. Conventional production train for continuous GTSP manufacture consisting of a reactor, granulator, dryer, and cooler. Design production capacity is 384 TPD P_2O_5 . The plant operated at 22 percent above design capacity during the test. EPA Method 13 was used. The control system conducted all process gases to two venturi scrubbers followed by a cyclonic scrubber, then a spray-crossflow packed scrubber. Gypsum pond water was used as the scrubbing medium in all scrubbers. Opacity of exhaust gases was less than 10 percent.

FIGURE 5
FLUORIDE EMISSIONS FROM GRANULAR TRIPLE SUPERPHOSPHATE
PRODUCTION PLANTS

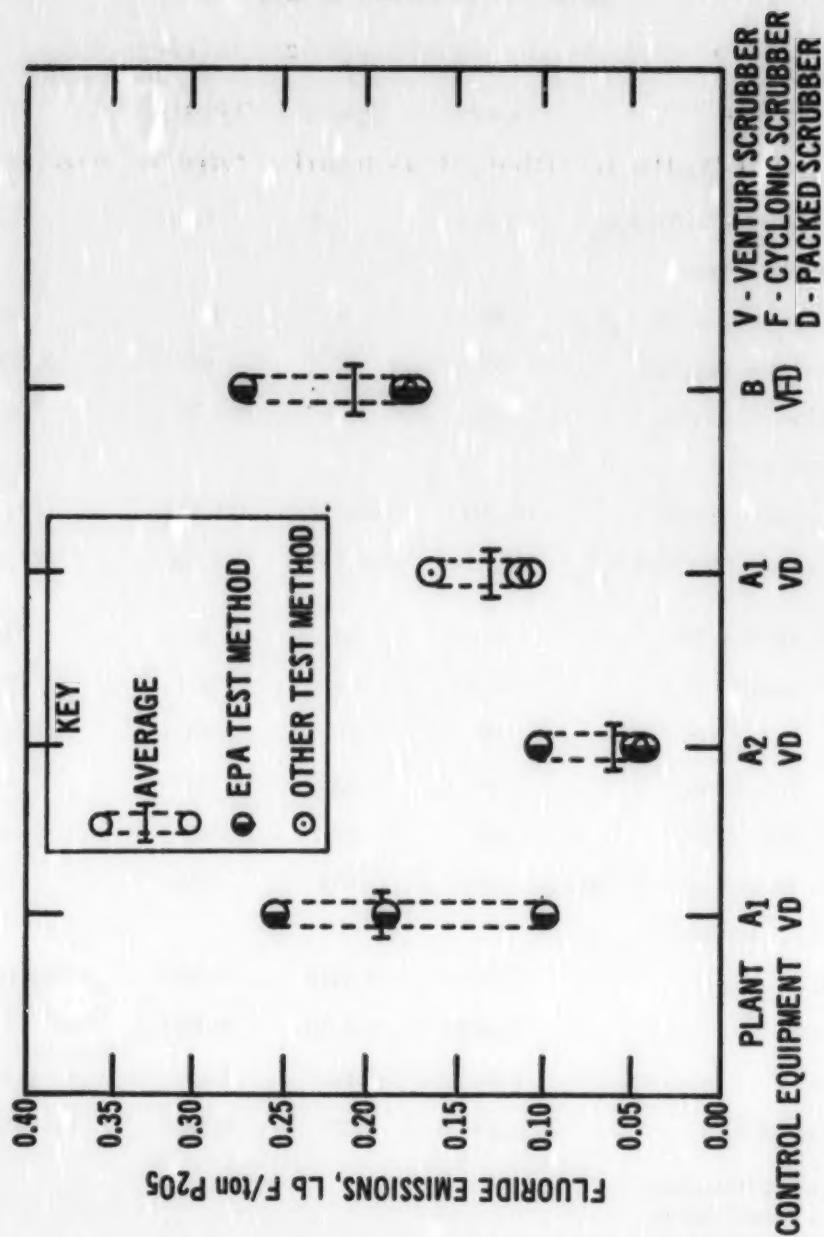


Table 24
FACILITY A₁
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	1/25/72	1/25/72	1/26/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	10.9	10.9	11.2	11.0
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	1-5(a)
L/G ratio - gal/SCF	NM	NM	NM	0.012(b)
No. transfer units	3.28	3.16	2.55	3.00
Stack Effluent				
Flow rate - DSCFM	103,106	103,267	105,651	104,008
Flow rate - DSCF/ton P ₂ O ₅	567,556	568,442	565,988	567,329
Temperature - °F	88	90	84	87
Water vapor - Vol. %	2.4	2	2.1	2.2
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0032	0.0012	0.0022	0.0022
gr/ACF	0.0030	0.0012	0.0021	0.0021
lb/hr	2.83	1.06	2.01	1.97
lb/ton of P ₂ O ₅	0.26	0.097	0.18	0.18

NM - Not Measured

(a) - Normal Range

(b) - Estimated

Reference 1.

Table 25
FACILITY A₂
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	9/11/72	9/11/72	9/12/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P ₂ O ₅	12	12	12	12
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	1-5 ^(a)
L/G ratio - gal/SCF	NM	NM	NM	0.012 ^(b)
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	109,554	108,552	90,146	102,751
Flow rate - DSCF/ton P ₂ O ₅	547,770	542,760	450,730	513,753
Temperature - °F	82.2	80.9	87.7	83.3
Water vapor - Vol. %	4.5	4.4	4.6	4.5
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0013	0.00059	0.00068	0.00086
gr/ACF	0.0012	0.0005	0.0006	0.0008
lb/hr	1.201	0.544	0.525	0.757
lb/ton of P ₂ O ₅	0.100	0.045	0.044	0.0632

NM - Not Measured
(a) - Normal Range
(b) - Estimated

Reference 2.

Table 26
FACILITY A₁
Summary of Results of Test by Operator

Run Number	1	2	3	4	Average
Date	1/24/72	1/25/72	1/25/72	1/25/72	-
Test time - minutes	NR	NR	NR	NR	NR
Production rate - TPH P ₂ O ₅	NR	NR	NR	NR	NR
Scrubber Operation					
Pressure drop - In. H ₂ O	NR	NR	NR	NR	NR
L/G ratio - gal/SCF	NR	NR	NR	NR	NR
No. transfer units	NR	NR	NR	NR	NR
Stack Effluent					
Flow rate - DSCFM	NR	NR	NR	NR	NR
Flow rate - DSCF/ton P ₂ O ₅	NR	NR	NR	NR	NR
Temperature - °F	NR	NR	NR	NR	NR
Water vapor - Vol. %	NR	NR	NR	NR	NR
CO ₂ - Vol. % dry	NR	NR	NR	NR	NR
O ₂ - Vol. % dry	NR	NR	NR	NR	NR
CO - Vol. % dry	NR	NR	NR	NR	NR
Visible Emissions - % opacity	NR	NR	NR	NR	NR
Fluoride Emissions					
gr/DSCF	NR	NR	NR	NR	NR
gr/ACF	NR	NR	NR	NR	NR
lb/hr	1.82	1.13	1.16	1.18	1.32
lb/ton of P ₂ O ₅ (a)	0.166	0.103	0.106	0.107	0.120
NR - Not Reported					

(a) - Calculated using average ton/hr P₂O₅ fed on 1/19/72 and reported lb/hr fluoride emissions.
Reference 3.

Table 27
FACILITY A
SUMMARY OF VISIBLE EMISSIONS (1)

Date: 3/1/74

Type of Plant: Granular Triple Superphosphate

Type of Discharge: Stack from scrubber

Location of Discharge: Top of stack

Height of Point of Discharge: ~ 200 ft

Description of Background: Sky

Distance from Observer to Discharge Point: ~ 700 ft

Height of Observation Point: Ground level

Direction of Observer from Discharge Point: West

Description of Sky: Clear

Wind Direction: Calm

Color of Plume: White

Interference of Steam Plume: Yes

Duration of Observation: 4 hrs.

Wind Velocity: Calm

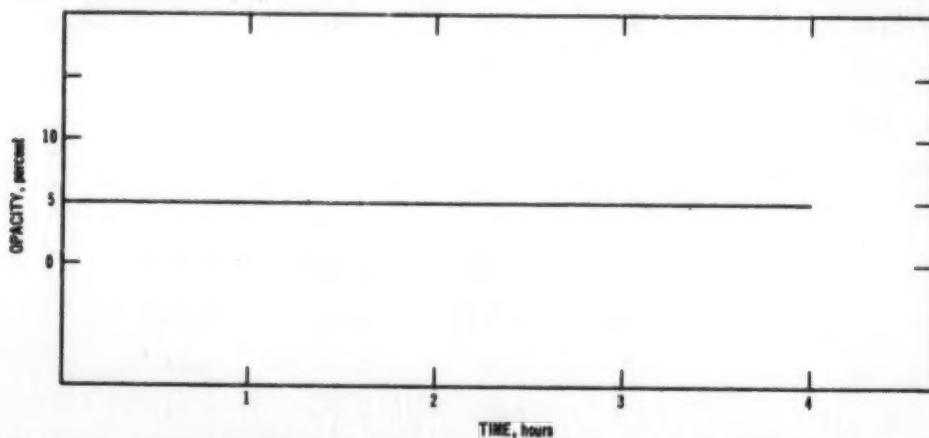
mi/hr

Detached Plume: No

Summary of Data:

Opacity, Percent	Total Time Equal to or Greater Than Given Opacity		Opacity, Percent	Total Time Equal to or Greater Than Given Opacity	
	Min.	Sec.		Min.	Sec.
5	240	0	55	-	-
10	0	0	60	-	-
15	-	-	65	-	-
20	-	-	70	-	-
25	-	-	75	-	-
30	-	-	80	-	-
35	-	-	85	-	-
40	-	-	90	-	-
45	-	-	95	-	-
50	-	-	100	-	-

Sketch Showing How Opacity Varied With Time:



(1) Two observers made simultaneous readings. The greater of their readings is reported.

Reference 4.

Table 2B
FACILITY B
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	6/14/72	6/15/72	6/15/72	-
Test time - minutes	120	120	120	120
Production rate - TPH P_2O_5	13.4	15.2	15.1	14.6
Scrubber Operation				
Pressure drop - In. H_2O	NM	NM	NM	2-6 ^(a)
L/G ratio - gal/SCF	0.0018	0.0019	0.0020	0.0019
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	109,548	103,555	102,729	105,277
Flow rate - DSCF/ton P_2O_5	490,513	408,770	408,195	435,826
Temperature - °F	121	126	127	125
Water vapor - Vol. %	2.9	5.6	6.3	4.9
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0040	0.0030	0.0031	0.0034
gr/ACF	0.0035	0.0025	0.0027	0.0029
lb/hr	3.73	2.64	2.76	3.04
lb/ton of P_2O_5	0.278	0.174	0.182	0.211

NM - Not Measured
(a) - Design Range
Reference 5.

REFERENCES

Granular Triple Superphosphate Production Plant Data

1. Emission Test Report for GTSP Facility A, prepared for EPA by Environmental Engineering, Inc., Contract No. CPA 70-82, EPA Test No. 72-CI-5A.
2. Emission Test Report for GTSP Facility A (Retest), prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 73-FRT-9.
3. Data supplied to EPA by the owner of GTSP Facility A.
4. "A Review of Field Conditions and Observational Variables Encountered During the Determination of Visible Emissions in the Phosphate Industry for the Environmental Protection Agency," March, 1974, prepared for EPA by Environmental Science and Engineering, Inc.
5. Emission Test Report for GTSP Facility B, prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 72-CI-30.

GRANULAR TRIPLE SUPERPHOSPHATE (GTSP) STORAGE FACILITIES

Fluoride Test Results

A test program was undertaken by EPA to evaluate the best fluoride control equipment available for installation on new or substantially modified GTSP storage facilities. Two facilities, identified as A and B, were tested by EPA. Data submitted by the operator of plant B are also included. Both plants use scrubbers to control fluorides. These scrubbers were operating normally during the EPA tests.

Figure 6 presents the emission rates (pounds per hour of fluorides per ton of P_2O_5 in storage) for the two facilities.

Facilities

- A. Typical open bay type storage building designed for a maximum capacity of 6,900 tons of P_2O_5 . The building was about 21 percent full during the EPA test. GTSP is loaded into the building by an overhead conveyor. Fresh air enters through ducts on the opposite side of the building. Fumes and dust are exhausted from the building by ducts along one side and are removed from the exhaust gases by a spray-crossflow packed scrubber. Gypsum pond water is used as the absorbing medium. EPA data are based on samples obtained using Method 13. Opacity of exhaust gases was less than 10 percent.
- B. Typical open bay type storage building designed for a maximum capacity of 16,000 tons P_2O_5 . EPA tested this facility twice (tests are designated B_1 and B_2). The building was about 30 percent full during the first EPA test (B_1) and the test conducted by the operator. It was

about 15 percent full during the second EPA test (B₂). A drag scraper or a front-end loader is used to move GTSP in the building. GTSP is loaded into the building by an overhead conveyor. Air enters the building through a vent running almost the length of the building on the roof. Fumes and dust are exhausted from the building by ducts along one side and are removed from exhaust gases by a spray-crossflow filter scrubber. Gypsum pond water is used as the absorption medium. EPA data is based on samples obtained using Method 13. The operator collected samples using the State of Florida method. Opacity of exhaust gases was less than 10 percent during the EPA tests. Additional visible emission data were obtained using EPA Method 9 by EPA and contractor personnel at another time.

FIGURE 6
FLUORIDE EMISSIONS FROM GRANULAR TRIPLE SUPERPHOSPHATE
STORAGE FACILITIES

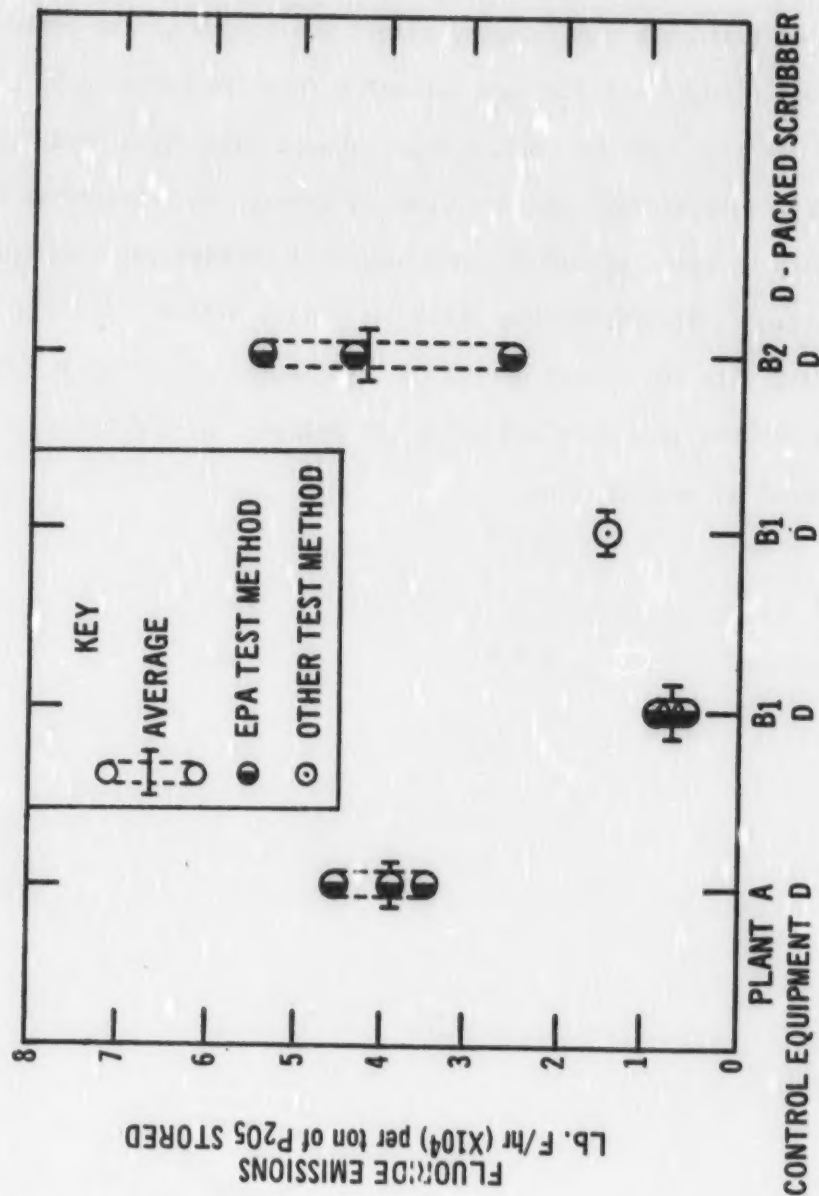


Table 29
FACILITY A
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	1/24/72	1/24/72	1/24/72	-
Test time - minutes	120	120	120	120
Tons P_2O_5 in Storage During Test	1,430	1,430	1,430	1,430
Scrubber Operation				
Pressure drop - In. H_2O	NM	NM	NM	-
L/G ratio - gal/SCF	NM	NM	NM	-
No. transfer units	1.1	0.56	1.1	0.92
Stack Effluent				
Flow rate - DSCFM	64,844	64,401	65,744	64,996
Flow rate - DSCFM/ton P_2O_5 stored	45.35	45.04	45.97	45.45
Temperature - °F	75	75	75	75
Water vapor - Vol. %	2.3	2.3	2.2	2.3
CO_2 - Vol. % dry	NM	NM	NM	-
O_2 - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0011	0.0008	0.0009	0.0009
gr/ACF	0.0010	0.0008	0.0008	0.0009
lb/hr	0.612	0.442	0.567	0.520
lb/hr per ton of P_2O_5 stored	0.00042	0.00031	0.00035	0.00036

NM - Not Measured

Reference 1.

Table 30
FACILITY B,
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	6/14/72	6/14/72	6/15/72	-
Test time - minutes	120	120	120	120
Tons of P ₂ O ₅ in Storage During Test	4,318	4,625	4,685	4,543
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	4.7 ^(a)
L/G ratio - gal/SCF	0.028	0.029	0.028	0.028 ^(b)
No. transfer units	NM	NM	NM	NM
Stack Effluent				
Flow rate - DSCFM	64,587	62,633	63,658	63,640
Flow rate - DSCFM/ton P ₂ O ₅ stored	14.96	13.54	13.59	14.03
Temperature - °F	81	80	81	81
Water vapor - Vol. %	3.9	3.5	3.6	3.7
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0005	0.0005	0.0005	0.0005
gr/ACF	0.0005	0.0004	0.0005	0.0005
lb/hr	0.279	0.245	0.276	0.267
lb/hr per ton of P ₂ O ₅ stored	0.00006	0.00005	0.00006	0.00006

NM - Not Measured

(a) - Design range

(b) - Calculated using measured DSCFM and design liquid flow rate, Reference 2.

Table 31
FACILITY B₁
Summary of Results of Test by Operator

Run Number	1
Date	5/19/72
Test time - minutes	30
Tons of P ₂ O ₅ stored during test	2782
Scrubber Operation	
Pressure drop - In. H ₂ O	2.8
L/G ratio - gal/SCF	NM
No. transfer units	NM
Stack Effluent	
Flow rate - DSCFM	81,970
Flow rate - DSCF/ton P ₂ O ₅ stored	29.46
Temperature - °F	82°F
Water vapor - Vol. %	3.2
CO ₂ - Vol. % dry	NM
O ₂ - Vol. % dry	NM
CO - Vol. % dry	NM
Visible Emissions - % opacity	NM
Fluoride Emissions	
gr/DSCF	0.0400
gr/ACF	0.0377
lb/hr	0.43
lb/hr per ton of P ₂ O ₅ stored	0.00015

NM - Not Measured
Reference 3.

Table 32
FACILITY B₂
Summary of Results of Test by EPA

Run Number	1	2	3	Average
Date	9/21/72	9/21/72	9/22/72	-
Test time - minutes	120	120	120	120
Tons of P ₂ O ₅ in Storage During Test	2,031	2,094	2,179	2,101
Scrubber Operation				
Pressure drop - In. H ₂ O	NM	NM	NM	4-7 ^(a)
L/G ratio - gal/SCF	0.023	0.022	0.023	0.022 ^(b)
No. transfer units	NM	NM	NM	-
Stack Effluent				
Flow rate - DSCFM	78,044	81,289	77,078	78,804
Flow rate - DSCFM/ton P ₂ O ₅ stored	38.42	38.82	35.37	37.54
Temperature - °F	81.6	88.0	76.8	84.5
Water vapor - Vol. %	2.9	1.4	2.9	2.4
CO ₂ - Vol. % dry	NM	NM	NM	-
O ₂ - Vol. % dry	NM	NM	NM	-
CO - Vol. % dry	NM	NM	NM	-
Visible Emissions - % opacity	<10	<10	<10	<10
Fluoride Emissions				
gr/DSCF	0.0020	0.0007	0.0016	0.0014
gr/ACF	0.0019	0.0007	0.0015	0.0014
lb/hr	1.334	0.503	1.040	0.959
lb/hr per ton of P ₂ O ₅ stored	0.0007	0.0002	0.0005	0.0005

NM - Not Measured

(a) - Design range

(b) - Calculated using measured DSCFM and design liquid flow rate.

Reference 4.

Table 33
FACILITY B
SUMMARY OF VISIBLE EMISSIONS (1)

Date: 2/25/74

Type of Plant: Granular Triple Superphosphate Storage

Type of Discharge: Stack from scrubber

Location of Discharge: Top of stack

Height of Point of Discharge: 100 ft

Description of Background: sky

Distance from Observer to Discharge Point: 300 ft

Height of Observation Point: Ground level

Direction of Observer from Discharge Point: East

Description of Sky: Light haze

Wind Direction: From South

Color of Plume: White

Interference of Steam Plume: yes

Duration of Observation: 4 hrs.

Wind Velocity: ~ 5

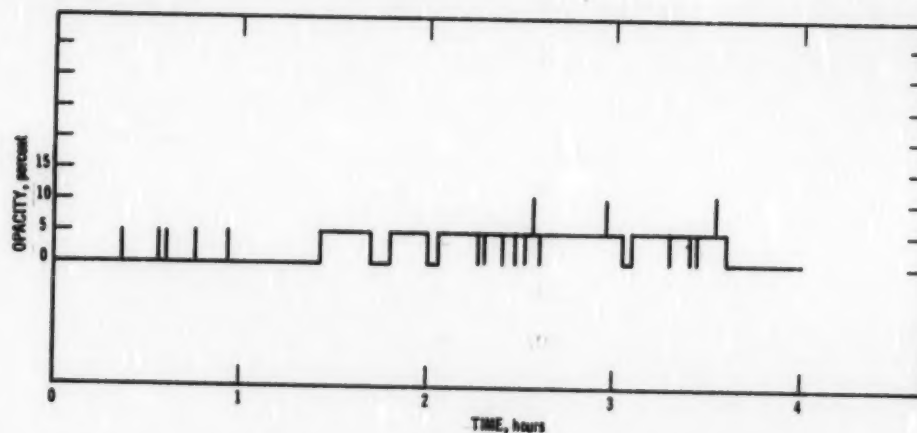
mi/hr

Detached Plume: No

Summary of Data:

Opacity, Percent	Total Time Equal to or Greater Than Given Opacity		Opacity, Percent	Total Time Equal to or Greater Than Given Opacity	
	Min.	Sec.		Min.	Sec.
5	90	30	55	-	-
10	11	0	60	-	-
15	0	0	65	-	-
20	-	-	70	-	-
25	-	-	75	-	-
30	-	-	80	-	-
35	-	-	85	-	-
40	-	-	90	-	-
45	-	-	95	-	-
50	-	-	100	-	-

Sketch Showing How Opacity Varied With Time:



(1) Two observers made simultaneous readings. The greater of their readings is reported.

Reference 5.

REFERENCES

Granular Triple Superphosphate Storage Facility Data

1. Emission Test Report for GTSP Storage Facility A, prepared for EPA by Environmental Engineering, Inc., Contract No. CPA-70-82, EPA Test No. 72-CI-5B.
2. Emission Test Report for GTSP Storage Facility B, prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232, EPA Test No. 72-CI-30B.
3. Data supplied to EPA by the owner of GTSP Storage Facility B.
4. Emission Test Report for GTSP Storage Facility B (Retest), prepared for EPA by Environmental Engineering, Inc., Contract No. 68-02-0232.
5. "A Review of Field Conditions and Observational Variables Encountered During the Determination of Visible Emissions in the Phosphate Industry for the Environmental Protection Agency," March, 1974, prepared for EPA by Environmental Science and Engineering, Inc.